I CLAIM:

1. An apparatus for separating a particle stream into particle groups, comprising:

a dilution treatment chamber defining an upstanding channel having a particle inlet at a top end, and a first-particle group outlet at a bottom end, the channel being adapted to receive a particle stream at the particle inlet such that the particle stream falls toward the first-particle-group outlet;

a transfer casing adjacent to the dilution treatment chamber and defining a transfer chamber adapted to receive a second particle group;

at least one second-particle-group outlet laterally positioned with respect to the channel of the dilution treatment chamber and allowing fluid communication between the transfer chamber and the channel;

a distributor in the channel between the particle inlet and the at least one second-particle-group outlet, for breaking down the particle stream and distributing the particle stream over a surface area of the channel; and

at least one fluid flow aperture in the dilution treatment chamber and below the distributor, adapted to create a fluid flow between the transfer chamber and the channel so as to entrain a second particle group from the channel through the second-particle-group outlet to the transfer chamber with a first particle group remaining in the channel for exiting through the first-particle-group outlet, the apparatus being adapted to be connected to a positive pressure source to create the fluid flow.

2. The apparatus according to claim 1, further comprising a pretreatment module at the particle inlet of the dilution treatment chamber, to guide the particle stream and to cause a horizontal dilution of the particle stream.

3. The apparatus according to claim 2, wherein the pretreatment module has at least one slide portion sloping downwardly toward the particle inlet of the dilution treatment chamber for guiding and accelerating a particle stream to the dilution treatment chamber, and a deflecting surface between the slide and the particle inlet for breaking down the particle stream and for imparting the horizontal dilution to the particle stream.

4. The apparatus according to claim 1, wherein at least one of the fluid flow apertures is used to inject an additive into the first particle group.

5. The apparatus according to claim 1, wherein the at least one second-particle-group outlet and the at least one fluid flow aperture are horizontally aligned and on opposite sides of the channel of the dilution treatment chamber.

6. The apparatus according to claim 5, wherein a nozzle adapted to be connected to the positive pressure source is connected to the fluid flow aperture so as to inject fluid in the channel to create the fluid flow between the channel and the transfer chamber.

7. The apparatus according to claim 1, wherein the distributor has an aperture laterally positioned in the channel, and a fluid-injection nozzle adapted to be connected to the positive pressure source and connected to the dilution aperture for injecting fluid in the channel of the dilution treatment chamber, for breaking down the particle stream and distributing the particle stream over a surface area of the channel.

8. The apparatus according to claim 1, wherein the distributor has one of an impeller, an ultrasound system and a reciprocating strainer.

9. The apparatus according to claim 1, further comprising a recuperation tray, positioned out of the channel in the transfer chamber and below the second-particle-group outlet for collecting particles of the first particle group deflected or forced out of the channel by the flow of fluid, and for returning the particles of the first particle group to a remainder of the first particle group.

10. The apparatus according to claim 1, wherein the transfer casing has an outlet at a bottom end thereof, for collecting the second particle group received in the transfer casing.

11. The apparatus according to claim 1, wherein the transfer chamber of the transfer casing is segmented into laterally adjacent upstanding receptacles to further separate the second particle group according to the distance over which the particles of the second particle group are entrained by the flow of fluid.

12. A method for separating a particle stream into particle groups, comprising the steps of:

i) vertically diluting the particle stream by directing the particle stream to a falling condition within a channel;

ii) breaking down the particle stream by subjecting the particle stream to lateral forces so as to distribute the particle stream over a surface area of the channel;

iii) entraining a particle group away from a remainder of the particle stream by creating a fluid flow of predetermined magnitude across the particle stream in said falling condition; and

iv) collecting the particle group and the remainder of the particle stream at separate locations.

13. The method according to claim 12, further comprising a step of horizontally diluting the particle stream by providing a horizontal velocity to the particle stream prior to step i).

14. The method according to claim 12, wherein step ii) includes injecting a fluid into the particle stream to break down said mass and distribute the particle stream over the surface area of the channel.

15. The method according to claim 12, wherein step iv) includes collecting the particle group into at least two particle subgroups by providing at least two collecting locations for the particle group, so as to collect particles in the subgroups according to a distance of entrainment of the particles.

16. An apparatus for at least one of mixing and treating particle and/or fluid streams, comprising:

a dilution treatment chamber defining an upstanding channel having an inlet at a top end, and an outlet, the channel being adapted to receive said particle and/or fluid streams at the inlet such that said particle and/or fluid streams fall toward the outlet;

at least one fluid flow aperture in the dilution treatment chamber, adapted to create a generally lateral flow of at least one of a fluid and particle jet within the channel to create a turbulence in the channel for at least one of mixing said particle and/or fluid streams and treating said particle and/or fluid streams , whereby a mixture and/or treated matter will exit the channel at the outlet; and

a positive pressure source connected to the fluid flow aperture to create the lateral flow of the at least one of the fluid and the particle jet.

17. The apparatus according to claim 16, further comprising a particle pretreatment module at the inlet of the dilution treatment chamber, to cause a horizontal dilution of said particle and/or fluid streams.

18. The apparatus according to claim 17, wherein the particle pretreatment module has at least one slide portion sloping downwardly toward the inlet of the dilution treatment chamber for guiding said particle and/or fluid streams to the dilution treatment chamber, and a deflector surface between the slide and the inlet for breaking down said particle and/or fluid streams and for imparting the horizontal dilution to said particle and/or fluid streams.

19. The apparatus according to claim 16, wherein a nozzle interconnects the pressure source to the fluid flow aperture so as to create the flow of fluid in the channel.

20. A method for at least one of treating and mixing particle and/or fluid streams, comprising the steps of:

i) vertically diluting particle and/or fluid streams by directing particle and/or fluid streams to a falling condition;

ii) creating a lateral flow of fluid and/or a particle jet across the particle and/or fluid streams in said falling condition for at least one of mixing the particle and/or fluid streams by a turbulence resulting from the lateral flow of fluid and/or particle jet, and treating said particle and/or fluid streams; and

iii) collecting the mixture and/or treated matter below the lateral flow.

21. The method according to claim 20, further comprising a step of horizontally diluting the particle and/or fluid streams by providing a horizontal velocity to the particle and/or fluid streams prior to step i).